§1. Characteristic Patterns of Potential Profile of ECRH Plasmas in CHS

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Bifurcation property in potential profile in ECR heated plasma has been investigated in CHS by use of a heavy ion beam probe. It has been empirically known that the potential profile has been categorized into five patterns, as is shown in Fig.1.

Preliminary survey for their appearance on density was performed in hydrogen plasmas with 53GHz ECR heating whose power was fixed at P_{ECRH}=100kW. Figure 2 shows the central potential value as a function of density. This diagram has two critical values of the density where the property of the potential profile changes drastically. Below the first critical density of n_e=0.5x10^{13}cm^{-3}, there higher potential value of ~ 0.4kV is obtained in some shots. As density decreases further beyond the second critical value n_e=0.3x10^{13} cm^{-3}, the potential value often reaches ~1kV.

In the region (C) along the low dashed line with density of n_e<0.5-0.6x 10^{13}cm^{-3}, the potential profile shows a hill-shape. Below the first critical density along the middle dashed line (region-B), the potential profile exhibits the dome around the core (region-B). This pattern is important since the dome feature is an indicator of formation of internal transport barrier for electron. 1) Below the second critical density along the high dashed line (region-A), the foot-point of the dome moves to the outer radius of ρ=0.5. Then the profile alters into the bell-shape. The plasma is inferred to have a choice of three patterns in potential profile in this low-density regime.

As the density increases from n_e=0.6x10^{13}cm^{-3} along the low dashed line (region-D), the radial electric field in the periphery becomes negative with keeping positive around the core. Then the potential takes Mexican hat profiles. As the density increases and becomes close to the density limit at P_{ECRH}=100kW (region-E), the central positive value turns almost zero or slightly negative. The potential takes the well shape. In contrast to the lower density regime, the profile is uniquely determined in this higher density regime.

We have shown a preliminary result of bifurcation characteristics of electrostatic potential profile in ECR heated plasmas of CHS. A remaining future work is that the bifurcation diagram (Fig. 2) should be completed to include power dependence of appearance of the potential profile patterns.

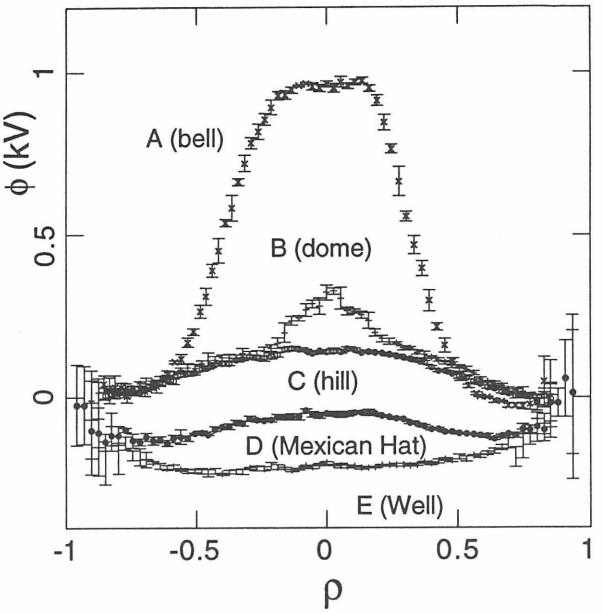
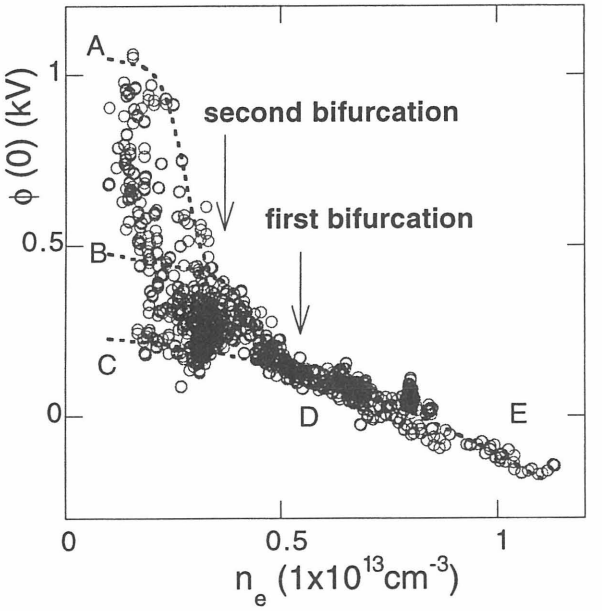


Fig. 1. Five typical shapes of potential profiles. The shapes are termed here (A) bell- (B) dome- (C) hill (D) Mexican hat- (E) well.



Fi.g. 2. Central potential value as a function of line-averaged density. In the low density regime, bifurcations of potential occur at two critical values of density.

Reference

1) A. Fujisawa et al., Phys. Rev. Lett. **82** 2669(1999).